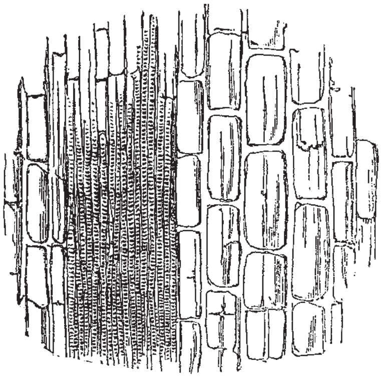
SUGAR

II.

THE Beet-root (*Beta vulgaris*) is a native of the south of Europe, and is said to have been introduced into England in 1656. It is a hardy biennial plant with reddish purple leaves and large fleshy roots, which in some varieties are long or spindle-shaped like a carrot, in others short and thick, almost like a turnip. The colour also varies, some forms being of a deep purple, while others are of a dirty white with a purple tinge. Internally the beet-root is of a blood-red colour. It is well known with us both as a pickle and as a salad plant, but it is much more extensively used even for these purposes in Germany and France than it is in England.

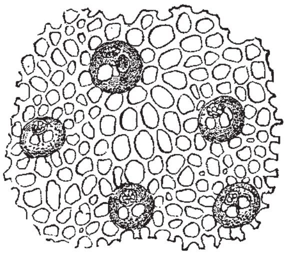
Numerous varieties of the beet are in cultivation, but one known on the Continent by the name of Betterave à Sucre is extensively grown as a sugar-producing plant; and the trade in beet-root sugar is a very important one throughout France, Belgium, Germany, and Russia. The bulk of the sugar consumed in these countries is furnished by this plant. Its cultivation for the produce of sugar has been more than once attempted in this country, but hitherto on too small a scale to be successful. Latterly, however, more attention has been paid to it, and more spirit and energy shown by those who have taken up the question towards overcoming obstacles that were at one time considered insurmountable; but whether the results will continue to prove remunerative remains to be seen. So long ago as 1837 a refinery solely for the manufacture of beet-root sugar was established at Chelsea; and many acres of land in the neighbourhood of London were devoted to the cultivation of beet. The discovery of the presence of sugar in beet was made in 1747 by a Prussian chemist named Margraaf, but his discovery was at first considered rather in the light of a scientific than of a practically useful character. It formed the subject of a communication to one of the learned societies in Berlin; and for several years afterwards the sugar so produced was considered an article of curiosity, and was consequently sold at fancy prices. Forty or fifty years elapsed before any experiments were made for the purpose of putting the discovery into practice, with the idea of extracting the sugar for actual use; these experiments however did not succeed, owing to the imperfect manner in which they were carried out; and the beet sugar manufacture would possibly even then have resulted in utter failure, had not Napoleon I., by excluding British Colonial produce from France, rendered it necessary for some new method to be devised for supplying France with sugar. Prizes were offered and many plans submitted. The Government, however, gave its support to the beet as the most likely source of success. Experiments were again renewed, and the result proved satisfactory, so that by 1812 this branch of manufacture was, for a time, placed on a firm footing in France. In 1814, however, the French markets again being opened, large quantities of cane sugar at once appeared from the West Indies, and beet sugar again fell into the background. A system of heavy and increasing duties continued to be levied upon colonial sugar till the year 1822, when the duty became so high as actually to amount to a prohibition to its entrance into French ports, and again the beet-root factories began to flourish. At the present time, or rather before the War broke out, hundreds of millions of pounds were made and consumed. Germany and France produce the largest quantity, Russia following close behind. It is, however, feared that the 300,000 tons of beet-root sugar, which was the estimated produce of France for 1870, will have been for the most part lost, owing to the interruption of the harvesting of the roots, and the consequent stoppage of the operations of the sugar factories.



LONGITUDINAL SECTION OF SUGAR-CANE, MAGNIFIED

Like the sugar-cane, the beet varies in quality and in the quantity of saccharine juice, according to the climate, soil, and mode of culture.

After the roots are dug up they are cleaned, usually by scraping them with a knife; they are then either sliced or rasped, and reduced to a pulp, which is placed in canvas bags and submitted to high pressure, by which means the juice is expressed. The pulp undergoes a second and sometimes a third squeezing, so as to obtain all the saccharine matter. This juice or liquor is then heated in a copper, and filtered and boiled with lime and water. A scum rises to the surface, which is taken off, and the juice is again boiled till it becomes of a proper consistency, when it is crystallised in a similar manner to cane sugar. Beet-root juice as expressed is very clammy to the touch, is nearly colourless, has a strong disagreeable smell, and contains a larger quantity of nitrogenous matter than cane juice. It is capable of being clarified and refined, so that it is made almost, if not quite, equal in appearance to the most superior descriptions of lump or moist sugar prepared from the sugar-cane.



TRANSVERSE SECTION OF SUGAR-CANE, MAGNIFIED

"Beet-root sugar is not only identical with cane sugar, but much of the Dutch lump sugar is actually the produce of beet-root. The circumstance cannot be too much insisted upon, that the seeming distinction between yellow beet sugar and yellow cane sugar depends on the extraneous coloured matters present. These, when eliminated by refining, leave white materials in all respects identical. There is positively no difference between these two, whether of colour or of grain. Grain or crystals can be developed from either to the size of the largest candy if desired; in fact, large white crystals produced from beet-root are sent in quantities from France into this country to compete with London, Bristol, Scotch, and other crystal manufactories."

As beet sugar has become of late in more general use in this country, so has cane sugar found its way in large quantities on the Continent. The mixing of these sugars can scarcely be considered in the light of adulteration, except when an inferior kind of one is mixed with a superior quality of another. The perfect system of filtering adopted in the manufacture of beet-root sugar causes it to be much freer from extraneous matters than

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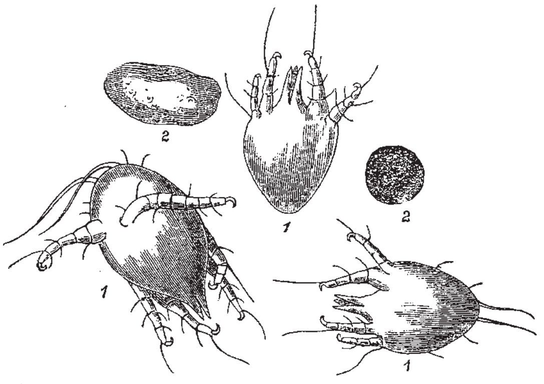
cane sugar, small pieces of the cane itself frequently occur in some descriptions of the latter. Of course it is impossible for them to be contained in loaf sugar, sugar-candy, or the finer kinds of sugar which undergo a careful process of purification.

A great deal has been said about the adulteration of sugar with sand, powdered marble, bone-dust, &c., and these tales are readily believed in by many people; but it is very unlikely that such insoluble substances would be used, as they would be sure to be detected. We know that inorganic substances are present in sugar, but we are inclined to believe that they are traceable to the imperfect cleaning of the cane or to the accidents, if we may so call them, attendant upon the process of manufacture.

Amongst the organic impurities often to be found in sugar, besides fragments of the cane before alluded to, are glucose or grape sugar, vegetable albumen, starch, minute fungi, and very frequently a number of small insects known as the sugar beetle (*Acarus sacchari*). The first of these, grape sugar, we have before described as being distinct from cane sugar, though its composition is nearly similar; as it is found most abundantly in grapes, whence its name; but it is also contained in various other fruits, as well in the dried state as in the fresh; and, moreover, it can be produced by the action of dilute sulphuric or other mineral acids, on starch or woody fibre, and so, in short, can be manufactured, which cane sugar cannot. It does not so readily crystallise as cane sugar, and the crystals are irregular, or have no definite form. It is much more clammy in an ordinary way, and dissolves or runs to juice at the least possible moisture of the atmosphere to which it is exposed. It is of less sweetening power than cane sugar, and is much more liable to ferment, therefore its presence with cane sugar tends to lessen the value of the latter.



MICROSCOPICAL APPEARANCE OF THE SUGAR INSECT (*Acarus sacchari*).—1. PERFECT INSECT.—2. OVA

The purest form of cane sugar to be obtained is that known as "lump," and for this reason it is always used in preserving fruit, as the chances of fermentation are thus diminished. Sugar-candy and all the large crystal or dry sugars are pretty sure to be free from glucose, because its presence would, according to the proportions, cause the sugar to be more or less clammy or moist. The presence of vegetable albumen and starch in cane-sugar is one step towards its conversion into grape sugar or glucose, and consequently increases its inclination to ferment. The removal of this vegetable albumen is one of the objects, as well as one of the difficulties, of perfect sugar refining.

The presence of minute fungi in sugar can only be detected by the aid of a microscope, but the sugar-beetle may be seen with an ordinary lens.

We know of no better way of detecting it along with other impurities than one which has been before recommended, namely, to place a teaspoonful or two of sugar in a glass of tepid water, let it stand till the sugar has completely dissolved, when the insects will be found, some perhaps at the top of the water and others at the bottom amongst the sediment. It is supposed that this insect is the cause of the irritation of the skin, more especially of the hands, from which grocers and those who have the handling of sugar are said to suffer.

Many other plants besides the sugar-cane and beet are used in their respective countries as sugar-producers. Thus, while we and our European neighbours receive our supplies from the two plants just alluded to, the chief sugar-producer in North America is a species of maple (*Acer saccharinum*), a large forest-tree; and in the East Indies several species of palms yield sugar.

With regard to the effects of sugar upon the system, it is abundantly proved that it is most valuable. Nature has so provided that it shall be diffused not only in the sap of young and growing plants, but also in milk, the food of the young of all Mammalia. Though sugar may be considered as a force producer, it is much more adapted to the young than to the adult, for it is not capable by itself of producing muscle.

JOHN R. JACKSON

NOTES

IN addition to the details given this week of the Eclipse Expedition by Mr. Lockyer and Mr. Langley, we have received from Prof. W. G. Adams a report of the Agosta section of the Expedition, publication of which we are compelled to defer till next week.

IT is with great pleasure we hear of the appointment of the Rev. F. W. Farrar to the Headmastership of Marlborough College. This institution has already set an example to our other public schools in the cultivation of Natural Science, which will, we trust, receive a fresh impulse under the new headmastership.

WE rejoice to hear that there is at last a chance of a large amount of scientific knowledge being required at the hands of naval and military officers. This is as it should be, and we earnestly hope that the long-needed reform will not stop here.

THE Austrian astronomers, MM. Weiss and Oppolzer, who went to Africa to observe the Eclipse, were, we regret to learn, as unfortunate as the other observers on that continent.

AT a meeting of the Master and Senior Fellows of Caius College, held December 14, 1870, the following College order was passed:—"That until as many as forty shares of the College income are applied to the promotion of the Natural Sciences and Experimental Physics, a sum equal to the deficit (estimated at 20*l.* a share) be taken from the balance for distribution, and paid to a fund called the 'Natural Science Fund.' That the shares applied to any Fellowship or Scholarship awarded for proficiency in the Natural Sciences and Experimental Physics be counted as so applied. That the Natural Science Fund be applied solely to the promotion of the study of Natural Sciences and Experimental Physics in any way whatever which, in the judgment of the College, may seem proper."

THE Birmingham and Midland Institute has done equal honour to Professor Huxley and to itself, by electing him to the office of President, in succession to the late Charles Dickens.

DR. WOOD has been appointed Lecturer on Chemistry at the St. Mary's Hospital Medical School, in succession to Dr. Russell, transferred to St. Bartholomew's.

WE understand that Dr. Michael Foster and Mr. Watts are engaged in translating Kühne's "Physiological Chemistry."

WE hope in succeeding numbers to give in full Dr. Carpenter's and Mr. Gwyn Jeffreys's Report on Deep-sea Researches carried on during the months of July, August, and September 1870, in the *Porcupine*, recently read before the Royal Society.

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